James City County Guidelines for Installing Solar Energy Systems

CONTENTS

Guidelines for Installing Solar Energy Systems

Introduction to the Guidelines for Installing Solar Energy Systems

This handout is to provide plan review and inspection guidelines for solar energy systems. Typical drawings are included that can be submitted for small residential solar energy installations, 15 k.w. or less and solar hot water systems to help insure a safe installation at a minimal cost to the customer. To use the County Typical drawings for residential systems the installation must comply with the attached structural and electrical Plan Review document part A.

For larger residential systems, commercial systems and systems that do not meet the requirements for using the county typical drawing a plan designed by a Registered Design Professional will need to be submitted for plan review.

The Solar Energy Systems Installation Certification form is included in this handout for contractor certification of the mounting attachments and the electrical wiring for roof top and inaccessible pedestal mounted solar energy systems.

Plan Review Requirements for Installation of Solar Energy Systems (Photovoltaic Panels and Solar Hot Water Systems) on Roofs and Ground Mounted.

Structural Requirements;

A. Residential Roof Installation:

1. **Requirements for Using County Details:**
   Structural design and plans for the installation of modules shall be prepared by a registered design professional (RDP) **OR** the installing contractor and submitted for review. In lieu of the design prepared by an RDP or the contractor, the **County details**[1] for the installation of solar energy systems can be used, provided the following conditions are met:
   A. The mounting structure is an engineered product designed and listed to mount modules.
   B. The roof truss system is an engineered product.
   C. Roof trusses/rafters shall not be over-spanned. Use *IRC span tables* to determine if your truss/rafter system is over-spanned.
   D. Building Structure is fully enclosed.
   E. Roof is flat, hip with pitch less than 27 degrees, or gable with pitch less than 45 degrees.
   F. The roof type is lightweight (dead load not greater than 20 PSF).
   G. The roof has single roof covering.
   H. The spacing between attachment points of the rails shall not exceed 4 ft.
   I. Provide the roof plan showing the layout of the modules.
   J. Provide manufacturer's installation recommendations and product specifications.
   K. The longer dimension of module shall not be more than 65 inches; the area shall be limited to 15 sq. ft. and the longer dimension shall be perpendicular to the supporting beam/rail.
   L. Module shall flush with roof /wall (Modules are parallel to the roof/wall surface with no more than 3" difference between ends of assembly; and with no more than 10" space between roof surface, and the bottom of the modules.
   M. Dead weight per attachment point will not exceed 45 lb.
   N. The distributed weight of the modules will not exceed 5 psf.

   The flow chart below is a guide to determine if you will comply with items M and N of the above conditions.
   1. Mounting System Manufacturer _____Product Name and Model#_____
   2. Total Dead Weight of Modules and Rails _____lbs
   3. Total Number of Attachment Points_____
   4. Weight per Attachment Point (b÷c) _____lbs
   5. Total Surface Area of Modules _____ square foot
   6. Distributed Weight of Module on Roof (b÷f) _____ lbs per square foot

If any of the above conditions listed in A through N are not met these details cannot be used.

[1] **The County Details shall be used in conjunction with manufacturer's installation instructions.**

Plan Review Requirements for Installation of Solar Energy Systems (Photovoltaic Panels and Solar Hot Water Systems) on Roofs and Ground Mounted. (Cont.)

2. **Solar Modules Requiring Designs by RDP / Contractor**
   If the roof system has:
   1. Rafter or trusses that are over-spanned or site built.
   2. The dead weight of the array is over 5 psf on any roof construction.
   3. The attachments points have dead loads exceeding 45 lbs.
   4. Module does not meet any of the conditions in Section A.1, A through N.

The following shall be provided:

1. Engineering calculations and details showing that the roof structure will support the modules.
2. A framing plan that shows details for how you will strengthen the truss/rafter.

Worksheet for evaluation of roof mounted modules

This section is for evaluating roof structural members that are site built or are not engineered trusses or rafters.

1. Roof construction: ☐ **Rafters** ☐ **Trusses** ☐ **Other**:
   _____
2. Describe site-built rafter or site-built truss system.
   A. Rafter Size: ___ x ___ inches
   B. Rafter Spacing: _____ inches
   C. Maximum unsupported span: _____ feet, _____ inches
   D. Are the rafters over-spanned? Use the span tables from *the applicable* International Residential Code (IRC) to determine if the rafters are over-spanned.

B. Commercial Installations:

All commercial module installations shall require design calculations and details of the structural supporting members by an RDP. Details shall include layout and attachment details.

C. Ground Mounted Module:

1. Mounting structure shall require engineering calculations and details by an RDP or AES contractor.
2. Details shall include module supports, framing members, foundation posts, footings and module attachment method to mounting structure.
3. Provide manufacturer's installation manual, including product specification.
4. Zoning Plat shall be submitted.

D. Inspections:

Penetrations through fire rated assemblies as a result of module installation shall be inspected. Refer to the section on inspections for other inspection requirements.

Plan Review Requirements for Installation of Solar Energy Systems (Photovoltaic Panels and Solar Hot Water Systems) on Roofs and Ground Mounted. (Cont.)

Electrical Requirements ;

A. Residential installation:

1. Requirements for using the County Typical details:
   A. Modules, utility interactive inverters and combiner boxes are identified and listed for use in PV systems.
   B. The PV array is composed of 4 strings or less per inverter.
   C. Maximum output is 15 KW.
   D. The AC Interconnection point is on the load side of the service disconnecting means.
   E. There are no battery storage provisions.
   F. The county typical electrical drawing can be used to accurately represent the PV System.
   G. Submit the manufacturer's specifications sheets and installation instruction manuals for the major components.
   H. An Electrical permit will be required for hot water systems if a circuit is added or extended.

2. PV System Installation that require designs by an RDP or Master Electrician for the Electrical Contractor:
   A. Systems over 15 KW.
   B. Over four strings of modules.
   C. Systems having battery storage capability.
   D. AC interconnection on the line side of the service disconnects.
   E. Ground mounted PV Systems.

B. Commercial Installations:

1. All commercial PV Installations require plans designed by a RDP or Licensed Master Electrician as determined by the Code of Virginia.

Mechanical Requirements:

1. Residential Installations:
   A. No plans are required.
   B. Must Comply with manufacturers installation instructions.

2. Commercial Installations:
   A. Plans are required for all hot water installations.

To complete the Permit Package provide the following:

2. A completed Permit Application.
3. The proposed site diagram showing the layout of the installation.
4. The County Typical electrical plan where applicable or an Electrical Plan designed by a RDP or Master Electrician.
5. The major components Specification sheets and the manufactures installation instructions.
6. Any Zoning Approvals as required for ground mounted and Commercial Solar Energy Systems.

Inspection Requirements for Installation of Solar Energy Systems (Photovoltaic Panels and Solar Hot Water Systems) on Roofs and Ground Mounted.

Building Inspection Guidelines:

A. Items required to be on site for Residential PV and Solar Hot Water Systems:

1. Approved county typical plans or county approved plans designed by an RDP.
2. All major component manufacturer specifications and installation instructions.
3. Contractor certification form for all residential roof and pedestal mounted PV and Solar Hot Water Installation.
4. A three feet perimeter is recommended to be provided on the roof between the module and the eaves of the roof for access

B. Roof and Pedestal Mount Installation for Residential Town House Installation:

1. System cannot overhang adjacent property line or be installed on or attached to adjacent property
2. All penetrations within four feet of the adjacent property line must be metallic materials (e.g. EMT)
3. A three feet perimeter is recommended to be provided on the roof between the module and the eaves of the roof for access

C. Items required to be on site for Commercial PV and Solar Hot Water Systems:

1. The county approved plans designed by an RDP are required to be on site.
2. The components are to be identified for use in PV and or Solar Hot Water systems.
3. All installation instructions are to be on site for the inspection.
4. Access to all components of the installation for inspection.
5. Systems installed on sloped roofs and non-accessible pedestals will require the contractor to certify the installation and submit the certification along with photographs of the installation.
6. A three feet perimeter is recommended to be provided on the roof between the module and the eaves or edges of the roof for access

D. Photo Evidence Required for Roof and Pedestal Mount for Residential and Non Accessible Commercial Installation:

1. Close up Photo of UL Listed Tag or Sticker on Solar Collector
2. Close up Photo of Attachment of Rack System
3. Close up Photo of Assembly of Rack System
4. Close up Photo of Attachment of Module to Rack System

Inspection Requirements for Installation of Solar Energy Systems (Photovoltaic Panels and Solar Hot Water Systems) on Roofs and Ground Mounted. (Cont.)

E. Certification for Residential and Non Accessible Commercial PV and Solar Hot Water Collectors mounted on Roofs or Pedestals:

1. Virginia Licensed AES Contractor will certify the installation and assembly of the rack system, attachment of rack system to the roof, the attachment of the solar collector to the rack system and all components are installed per the manufactures installation instructions and the county approved plans
2. Virginia Licensed AES Contractor will certify that all penetrations through the roof assembly are water and weather tight
3. Virginia Licensed AES Contractor will certify that a three feet perimeter is provided on the Roof between Solar Panel/Array and the eaves of the roof for access
4. Virginia Licensed AES Contractor license number and license holders original signature
5. If you are not a Virginia Licensed AES Contractor, you must have a county approved Third Party Engineer certify the installation on the roof

Electrical Inspection Guidelines:

A. Items required to be on site for Residential PV Systems:

1. Approved county typical plans or county approved plans designed by an RDP/Master Electrician.
2. All installation instructions are to be on site for the inspection.
3. Contractor certification form for all residential roof and pedestal mounted PV solar system wiring.

B. P. V. Systems Installed at Commercial Sites:

1. The county approved plans designed by an RDP or master electrician are required to be on site.
2. The components are to be identified for use in P.V. systems.
3. All installation instructions are to be on site for the inspection.
4. Access to all components of the installation for inspection.
5. Systems installed on sloped roofs and inaccessible pedestals will require the AES electrical contractor to certify the wiring installation and to submit the certification along with photographs of the installation.

Inspection Requirements for Installation of Solar Energy Systems (Photovoltaic Panels and Solar Hot Water Systems) on Roofs and Ground Mounted. (Cont.)

C. Photo Evidence Required for Residential and Non Accessible Commercial Roof and Pedestal Mount Installations:

1. Close up of modules and any micro inverters.
2. Module manufacturer's nameplate and testing laboratory approved label.
3. Close up of DC and AC wiring to show the type and size of conductors.
4. Close up of grounding connections at mounting racks and module connection to racks.
5. Close up of open combiner boxes, junction boxes and wiring connections.
6. Routing of wiring, conduits and conduit strapping.
7. Close up of wiring connections at any micro inverters.

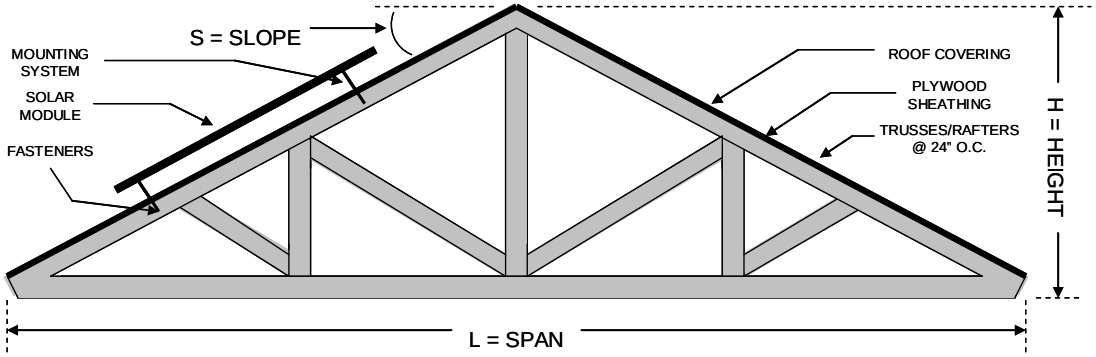
Inspection Requirements for Installation of Solar Energy Systems (Photovoltaic Panels and Solar Hot Water Systems) on Roofs and Ground Mounted. (Cont.)

Guidelines for Residential and Commercial Solar Hot Water installations:

1. The county approved plans must be on site and all major component manufacturer specifications and installation instructions.
2. All equipment, fittings, piping, and components located inside the structure must be accessible for inspection by county inspection staff
3. For pedestal mounted systems under ground piping installations will be inspected by county inspection staff
4. Commercial installation of testable Back Flow Prevention Devices must have an approved county listed testing agency provide the original test report at time of final inspection

COUNTY TYPICAL STRUCTURAL DETAILS FOR MODULES

Figure 1: ROOF STRUCTURE DETAIL



ROOF MEASURMENTS

L	
H	
S	

NOTES

1. All details not to scale.
2. JCC Details to be used in conjunction with manufacturers installation instructions.
3. JCC Ground Snow Load 20 PSF.
4. See IRC for span tables.
5. Blocking shall be properly secured per industry standards.
6. Pre-drilling of structural members is required for lag bolts.

Figure 2: ATTACHMENT LOCATION

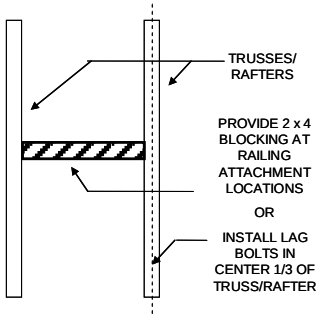
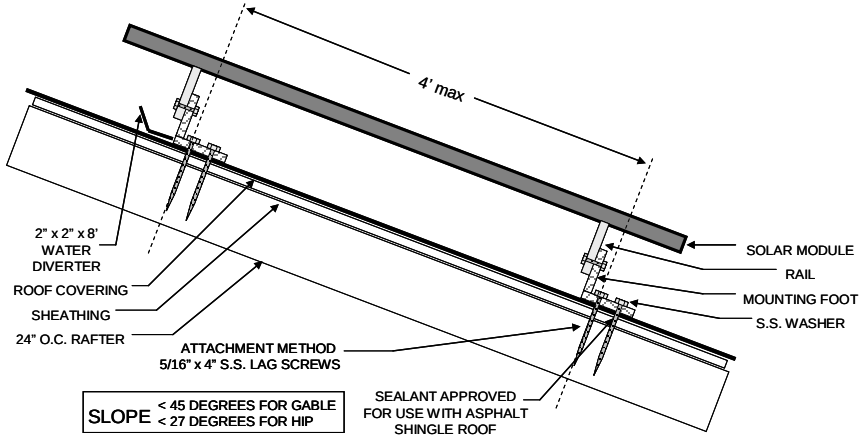


Figure 3: ATTACHMENT DETAIL



PROJECT INFORMATION

Site Address:_____
Prepared by:_____
Date: _____

ROOF SYSTEM INFORMATION

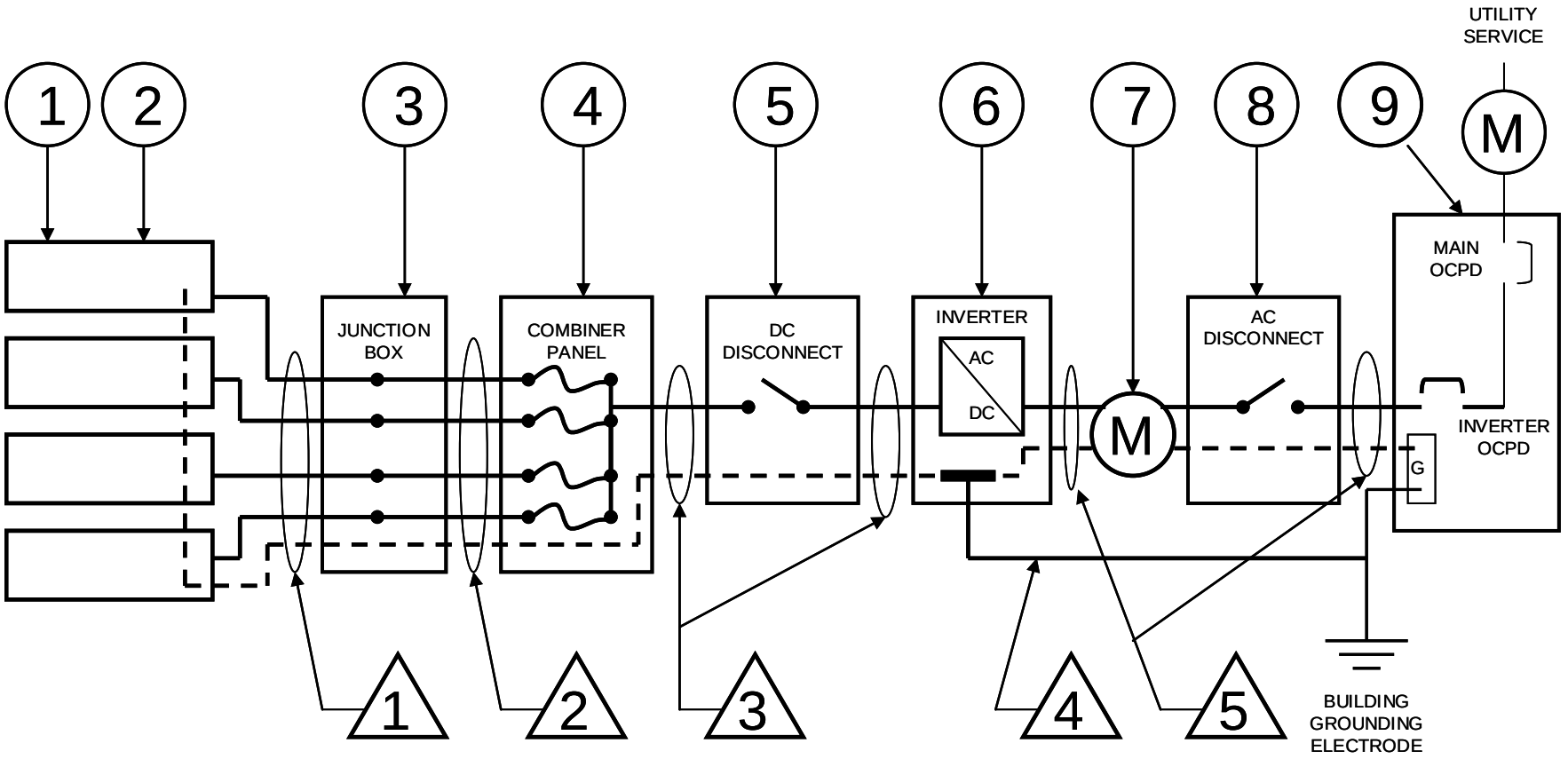
1. Roof construction: □ Rafters □ Trusses □ Other_____
2. Describe site built rafter or truss system.
   a. Rafter Size: _____ x _____ inches
   b. Rafter Spacing: _____ inches
   c. Maximum unsupported span: _____ feet, _____ inches
   d. Are the rafters over-spanned? (Use the IRC span tables)

MODULE ATTACHMENT INFORMATION

a. Mounting System Manufacturer _____
b. Product Name and Model Number _____
c. Total Dead Weight of PV Modules and Rails _____lbs
d. Total Number of Attachment Points _____
e. Weight per Attachment Point (c ÷ d) _____lbs
f. Total Surface Area of PV Modules _____ft2
g. Distributed Weight of PV Module on Roof (c ÷ f) _____lbs/ft2

JCC TYPICAL DRAWING FOR SMALL, SINGLE INVERTER SYSTEMS

Figure 4: SMALL SINGLE INVERTER SYSTEM DETAIL



Site Address: _____
Prepared by: _____
Date: _____

JCC TYPICAL DRAWING FOR SMALL, SINGLE INVERTER SYSTEMS
NOTES AND SCHEDULES

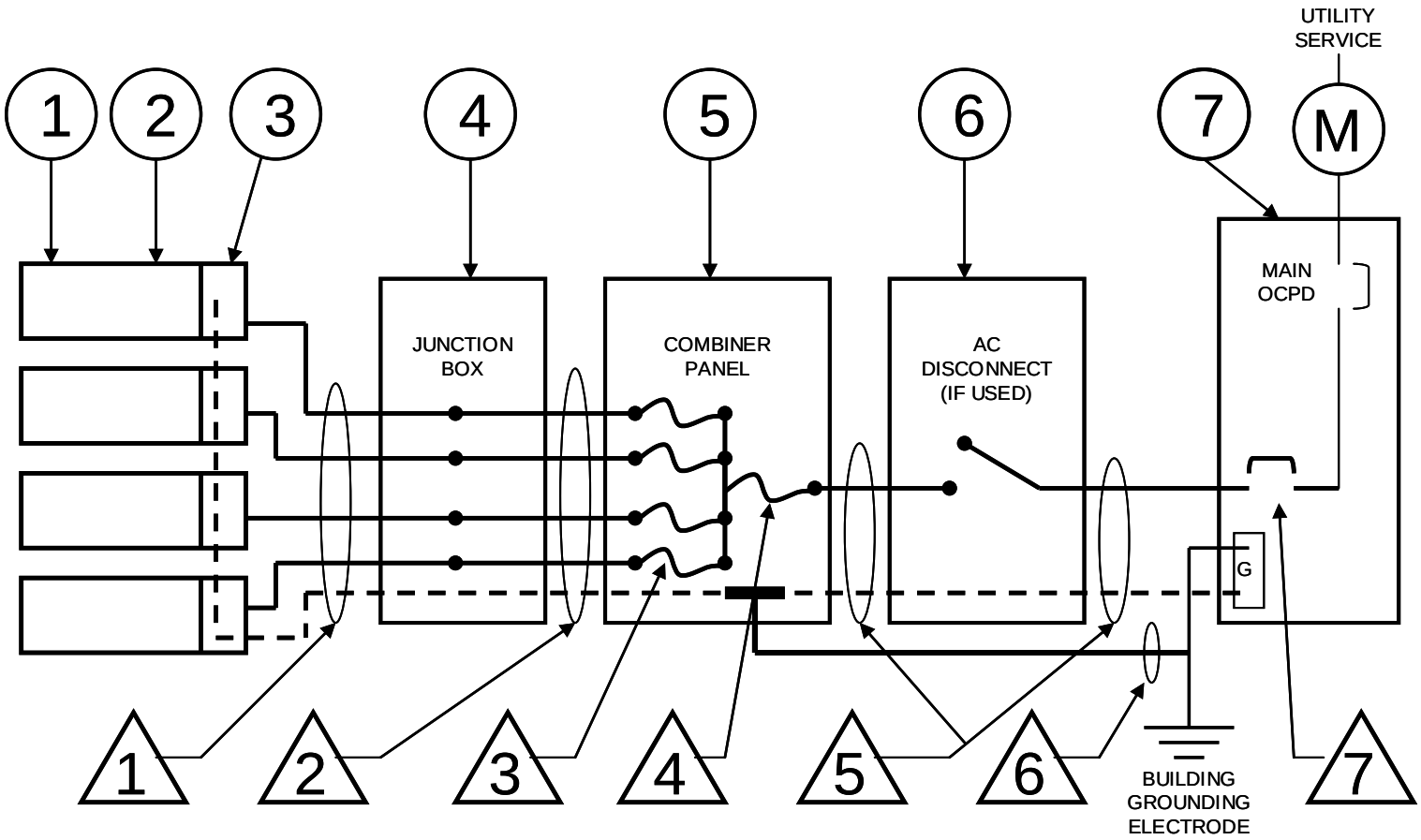
O	EQUIPMENT SCHEDULE					
TAG	DESCRIPTION	MODEL NUMBER	NOTES			
1	SOLAR PV MODULE					
2	PV ARRAY		_____Module	VOC_____V	ISC_____R	
3	J-BOX (IF USED)					
4	COMBINER PANEL					
5	DC DISCONNECT					
6	DC / AC CONVERTER		_____Watts	_____Volts	Max per Branch_____	
7	GEN METER (IF USED)					
8	AC DISCONNECT (IF USED)					
9	SERVICE PANEL		_____VAC	_____A Main	_____A Bus	_____A Inverter OCPD

Δ	CONDUIT AND CONDUCTOR SCHEDULE				
TAG	DESCRIPTION OR CONDUCTOR TYPE	CONDUCTOR GUAGE	NUMBER OF CONDUCTORS	CONDUIT TYPE	CONDUIT SIZE
1	USE-2 □ or PV WIRE □ BARE COPPER EQ. GRD. COND. (EGC)			N/A	N/A
2	THWN-2 □ or XHHW-2 □ or RHW-2 □ INSULATED EGC				
3	THWN-2 □ or XHHW-2 □ or RHW-2 □ INSULATED EGC				
4	GROUNDING ELECTRODE COND.				
5	SOLAR BACK-FED OCP _____AMPS			N/A	N/A

NOTES	
1	All labels will be placed in accordance with NEC 690.
2	The sum of all supply breakers feeding a busbar / conductor cannot exceed 120% of the busbar / conductor rating.
3	Interconnection within the main panel shall be located at the opposite end of the buss from the main breaker.
4	DC conductors inside structure must be installed in a metal raceway.
5	AC and DC disconnects must be grouped.

JCC TYPICAL DRAWING FOR SMALL, MICRO INVERTER / AC SYSTEMS

Figure 5: JCC SMALL MICRO INVERTER / AC SYSTEM DETAIL



Item 5: Combiner Panel may not required in Microinverter Systems.

Site Address: _____
Prepared by: _____
Date: _____

JCC TYPICAL DRAWING FOR SMALL, MICRO INVERTER / AC SYSTEMS
NOTES AND SCHEDULES

O	EQUIPMENT SCHEDULE					
TAG	DESCRIPTION	MODEL NUMBER	NOTES			
1	SOLAR PV MODULE					
2	PV ARRAY		_____Module	VOC_____V	ISC_____R	
3	MICRO INVERTER		_____Watts	_____Volts	Max per Branch_____	
4	J-BOX (IF USED)					
5	COMBINER PANEL					
6	AC DISCONNECT					
7	SERVICE PANEL		_____VAC	_____A Main	_____A Bus	_____A Inverter OCPD

Δ	CONDUIT AND CONDUCTOR SCHEDULE				
TAG	DESCRIPTION OR CONDUCTOR TYPE	CONDUCTOR GUAGE	NUMBER OF CONDUCTORS	CONDUIT TYPE	CONDUIT SIZE
1	USE-2 □ or PV WIRE □ BARE COPPER EQ. GRD. COND. (EGC)			N/A	□/A
2	THWN-2 □ or XHHW-2 □ or RHW-2 □ INSULATED EGC				
3	A□RAY OCP _____AMPS			N/A	N/A
4	SOLAR OCP _____AMPS			N/A	N/A
5	THWN-2 □ or XHHW-2 □ or RHW-2 □ INSULATED EGC				
6	GROUNDING ELECTRODE COND.				
7	SOLAR BACK-FED OCP _____AMPS			N/A	N/A

NOTES	
1	All labels will be placed in accordance with NEC 690.
2	The sum of all supply breakers feeding a busbar / conductor cannot exceed 120% of the busbar / conductor rating.
3	Interconnection within the main panel shall be located at the opposite end of the main breaker.

SOLAR ENERGY SYSTEMS INSTALLATION CERTIFICATION

Self Certification Form for Rooftop Inspection. (Must have prior approval from JCC Bldg Official)

SITE ADDRESS_____ **MAP PAGE** _____

_____ **GRID #**: _____

JOB NAME _____

MASTER ELECTRICIAN	**GENERAL CONTRACTOR**	**PLUMBING CONTRACTOR_**
ELE PERMIT ___ -_____	**BLD PERMIT** ___-_____	**(Solar Water Heater)**
		PLB PERMIT ___-_____
NAME: _____	**NAME**: _____	**NAME**: _____
(Type or Print)	(Type or Print)	(Type or Print)
MASTER #: _____	**ADDRESS**: _____	**MASTER #**: _____
ADDRESS: _____	_____	**ADDRESS**: _____
_____	_____	_____
_____		_____
	STATE REGISTRATION #:	
	_____	
CLASS __ TEL # _____	CLASS __TEL # _____	CLASS __ TEL # _____

THE FOLLOWING BUILDING, PLUMBING AND/OR ELECTRICAL RELATED WORK WAS INSPECTED:

- ☐ All work is installed per County Approved Plans and manufacturer guidelines/installation instructions
- ☐ Listed rack system is attached to the structure per manufacturer requirements
- ☐ Solar Collector(s) are attached to the rack system per manufacturer requirements
- ☐ The Listed rack system is assembled per manufacturer requirements
- ☐ All Solar Panels are UL Listed and are installed for their specified use
- ☐ All penetrations through roof assembly are water and weather tight
- ☐ A minimum of a three feet perimeter is provided on the roof between the solar panels and the eaves of the roof for access
- ☐ Each Solar Panel is grounded using the supplied hardware
- ☐ Conductor type _____
- ☐ Conductor insulation _____
- ☐ Tempature-derated ampacity calculations
- ☐ Pressure terminals tightened to the recommended torque specification
- ☐ Pressure lugs or other terminals are listed for the environment
- ☐ Inverter(s) are UL Listed
- ☐ AC or DC grounding electrode conductors connected properly
- ☐ Wet-rated conductors are used in conduits in exposed locations

DATE OF INSPECTION(S): _____ TIME OF INSPECTION(S): _____

A COPY OF THE REQUIRED BUILDING, ELECTRICAL AND/OR PLUMBING PERMIT WAS POSTED ON THE CONTRUCTION SITE AT THE TIME OF THIS INSPECTION. I CERTIFY THAT THE INSTALLATION MEETS ALL REQUIREMENTS OF THE VIRGINIA UNIFORM STATEWIDE BUILDING CODE.

_____ _____

SIGNATURE OF MASTER ELECTRICIAN DATE

_____ _____

SIGNATURE OF MASTER MECHANICAL DATE

_____ _____

SIGNATURE OF AES CONTRACTOR DATE